WE CLAIM:

1. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps;

(2) said cooled natural gas stream is divided into at least a first stream and a second stream;

(3) said first stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(4) said second stream is expanded to said intermediate pressure;

(5) said expanded first stream and said expanded second stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(6) a vapor distillation stream is withdrawn from a region of said distillation column below said expanded second stream and is cooled sufficiently to condense at least a part of it, thereby forming a residual vapor stream and a reflux stream;

(7) said reflux stream is directed into said distillation column as a top feed thereto;

(8) said residual vapor stream is combined with said more volatile vapor distillation stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(9) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

2. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a liquid stream;

(3) said vapor stream is divided into at least a first stream and a second stream;

(4) said first stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(5) said second stream is expanded to said intermediate pressure;

(6) said liquid stream is expanded to said intermediate pressure;

(7) said expanded first stream, said expanded second stream, and said expanded liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) a vapor distillation stream is withdrawn from a region of said distillation column below said expanded second stream and is cooled sufficiently to condense at least a part of it, thereby forming a residual vapor stream and a reflux stream;

(9) said reflux stream is directed into said distillation column as a top feed thereto;

(10) said residual vapor stream is combined with said more volatile vapor distillation stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(11) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

3. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a liquid stream;

(3) said vapor stream is divided into at least a first stream and a second stream;

(4) said first stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(5) said second stream is expanded to said intermediate pressure;

(6) said liquid stream is expanded to said intermediate pressure and heated;

(7) said expanded first stream, said expanded second stream, and said heated expanded liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(8) a vapor distillation stream is withdrawn from a region of said distillation column below said expanded second stream and is cooled sufficiently to condense at least a part of it, thereby forming a residual vapor stream and a reflux stream;

(9) said reflux stream is directed into said distillation column as a top feed thereto;

(10) said residual vapor stream is combined with said more volatile vapor distillation stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(11) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

4. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a liquid stream;

(3) said vapor stream is divided into at least a first stream and a second stream;

(4) said first stream is combined with at least a portion of said liquid stream, forming thereby a combined stream;

(5) said combined stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(6) said second stream is expanded to said intermediate pressure;

(7) any remaining portion of said liquid stream is expanded to said intermediate pressure;

(8) said expanded combined stream, said expanded second stream, and said expanded remaining portion of said liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) a vapor distillation stream is withdrawn from a region of said distillation column below said expanded second stream and is cooled sufficiently to condense at least a part of it, thereby forming a residual vapor stream and a reflux stream;

(10) said reflux stream is directed into said distillation column as a top feed thereto;

(11) said residual vapor stream is combined with said more volatile vapor distillation stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(12) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

5. In a process for liquefying a natural gas stream containing methane and heavier hydrocarbon components wherein

(a) said natural gas stream is cooled under pressure to condense at least a portion of it and form a condensed stream; and

(b) said condensed stream is expanded to lower pressure to form said liquefied natural gas stream;

the improvement wherein

(1) said natural gas stream is treated in one or more cooling steps to partially condense it;

(2) said partially condensed natural gas stream is separated to provide thereby a vapor stream and a liquid stream;

(3) said vapor stream is divided into at least a first stream and a second stream;

(4) said first stream is combined with at least a portion of said liquid stream, forming thereby a combined stream;

(5) said combined stream is cooled to condense substantially all of it and thereafter expanded to an intermediate pressure;

(6) said second stream is expanded to said intermediate pressure;

(7) any remaining portion of said liquid stream is expanded to said intermediate pressure and heated;

(8) said expanded combined stream, said expanded second stream, and said heated expanded remaining portion of said liquid stream are directed into a distillation column wherein said streams are separated into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) a vapor distillation stream is withdrawn from a region of said distillation column below said expanded second stream and is cooled sufficiently to condense at least a part of it, thereby forming a residual vapor stream and a reflux stream;

(10) said reflux stream is directed into said distillation column as a top feed thereto;

(11) said residual vapor stream is combined with said more volatile vapor distillation stream to form a volatile residue gas fraction containing a major portion of said methane and lighter components; and

(12) said volatile residue gas fraction is cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

6. The improvement according to claim 1, 2, 3, 4, or 5 wherein a liquid distillation stream is withdrawn from said distillation column at a location above the region wherein said vapor distillation stream is withdrawn, whereupon said liquid distillation stream is heated and thereafter redirected into said distillation column as another feed thereto at a location below the region wherein said vapor distillation stream is withdrawn.

7. The improvement according to claim 1, 2, 3, 4, or 5 wherein said reflux stream is divided into at least a first portion and a second portion, whereupon said first portion is directed into said distillation column as a top feed thereto, and said second portion is supplied to said distillation column as another feed thereto, at a feed location in substantially the same region wherein said vapor distillation stream is withdrawn.

8. The improvement according to claim 6 wherein said reflux stream is divided into at least a first portion and a second portion, whereupon said first portion is directed

into said distillation column as a top feed thereto, and said second portion is supplied to said distillation column as another feed thereto, at a feed location in substantially the same region wherein said vapor distillation stream is withdrawn.

9. The improvement according to claim 1, 2, 3, 4, or 5 wherein said volatile residue gas fraction is compressed and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

10. The improvement according to claim 6 wherein said volatile residue gas fraction is compressed and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

11. The improvement according to claim 7 wherein said volatile residue gas fraction is compressed and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

12. The improvement according to claim 8 wherein said volatile residue gas fraction is compressed and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

13. The improvement according to claim 1, 2, 3, 4, or 5 wherein said volatile residue gas fraction is heated, compressed, and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

14. The improvement according to claim 6 wherein said volatile residue gas fraction is heated, compressed, and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

15. The improvement according to claim 7 wherein said volatile residue gas fraction is heated, compressed, and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

16. The improvement according to claim 8 wherein said volatile residue gas fraction is heated, compressed, and thereafter cooled under pressure to condense at least a portion of it and form thereby said condensed stream.

17. The improvement according to claim 1, 2, 3, 4, or 5 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

18. The improvement according to claim 6 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

19. The improvement according to claim 7 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

20. The improvement according to claim 8 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

21. The improvement according to claim 9 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

22. The improvement according to claim 10 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

23. The improvement according to claim 11 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

24. The improvement according to claim 12 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

25. The improvement according to claim 13 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

26. The improvement according to claim 14 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon

components selected from the group consisting of C_2 components and C_2 components + C_3 components.

27. The improvement according to claim 15 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

28. The improvement according to claim 16 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

29. An apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, which includes

(1) one or more first heat exchange means to receive said natural gas stream and cool it under pressure;

(2) dividing means connected to said first heat exchange means to receive said cooled natural gas stream and divide it into at least a first stream and a second stream;

(3) second heat exchange means connected to said dividing means to receive said first stream and to cool it sufficiently to substantially condense it;

(4) first expansion means connected to said second heat exchange means to receive said substantially condensed first stream and expand it to an intermediate pressure;

(5) second expansion means connected to said dividing means to receive said second stream and expand it to said intermediate pressure;

(6) a distillation column connected to said first expansion means and said second expansion means to receive said expanded first stream and said expanded second stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(7) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded second stream;

(8) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(9) separation means connected to said third heat exchange means to receive said cooled partially condensed distillation stream and separate it into a residual vapor stream and a reflux stream, said separation means being further connected to said distillation column to direct said reflux stream into said distillation column as a top feed thereto;

(10) combining means connected to said distillation column and said separation means to receive said more volatile vapor distillation stream and said residual vapor stream and form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(11) fourth heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said fourth heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby a condensed stream;

(12) third expansion means connected to said fourth heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream; and

(13) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

30. An apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, which includes

(1) one or more first heat exchange means to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said first heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a liquid stream;

(3) dividing means connected to said first separation means to receive said vapor stream and divide it into at least a first stream and a second stream;

(4) second heat exchange means connected to said dividing means to receive said first stream and to cool it sufficiently to substantially condense it;

(5) first expansion means connected to said second heat exchange means to receive said substantially condensed first stream and expand it to an intermediate pressure;

(6) second expansion means connected to said dividing means to receive said second stream and expand it to said intermediate pressure;

(7) third expansion means connected to said first separation means to receive said liquid stream and expand it to said intermediate pressure;

(8) a distillation column connected to said first expansion means, said second expansion means, and said third expansion means to receive said expanded first stream, said expanded second stream, and said expanded liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(9) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded second stream;

(10) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(11) second separation means connected to said third heat exchange means to receive said cooled partially condensed distillation stream and separate it into a residual vapor stream and a reflux stream, said second separation means being further connected to said distillation column to direct said reflux stream into said distillation column as a top feed thereto;

(12) combining means connected to said distillation column and said second separation means to receive said more volatile vapor distillation stream and said residual vapor stream and form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(13) fourth heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said fourth heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby a condensed stream;

(14) fourth expansion means connected to said fourth heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream; and

(15) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

31. An apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, which includes

(1) one or more first heat exchange means to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said first heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a liquid stream;

(3) dividing means connected to said first separation means to receive said vapor stream and divide it into at least a first stream and a second stream;

(4) second heat exchange means connected to said dividing means to receive said first stream and to cool it sufficiently to substantially condense it;

(5) first expansion means connected to said second heat exchange means to receive said substantially condensed first stream and expand it to an intermediate pressure;

(6) second expansion means connected to said dividing means to receive said second stream and expand it to said intermediate pressure;

(7) third expansion means connected to said first separation means to receive said liquid stream and expand it to said intermediate pressure;

(8) heating means connected to said third expansion means to receive said expanded liquid stream and heat it;

(9) a distillation column connected to said first expansion means, said second expansion means, and said heating means to receive said expanded first stream, said expanded second stream, and said heated expanded liquid stream, with said distillation column adapted to separate said streams into a more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(10) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded second stream;

(11) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(12) second separation means connected to said third heat exchange means to receive said cooled partially condensed distillation stream and separate it into a residual vapor stream and a reflux stream, said second separation means being further connected to said distillation column to direct said reflux stream into said distillation column as a top feed thereto;

(13) combining means connected to said distillation column and said second separation means to receive said more volatile vapor distillation stream and said residual vapor stream and form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(14) fourth heat exchange means connected to said combining means to receive said volatile residue gas fraction, with said fourth heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby a condensed stream;

(15) fourth expansion means connected to said fourth heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream; and

(16) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

32. An apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, which includes

(1) one or more first heat exchange means to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said first heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a liquid stream;

(3) dividing means connected to said first separation means to receive said vapor stream and divide it into at least a first stream and a second stream;

(4) first combining means connected to said dividing means and to said first separation means to receive said first stream and at least a portion of said liquid stream and form thereby a combined stream;

(5) second heat exchange means connected to said first combining means to receive said combined stream and to cool it sufficiently to substantially condense it;

(6) first expansion means connected to said second heat exchange means to receive said substantially condensed combined stream and expand it to an intermediate pressure;

(7) second expansion means connected to said dividing means to receive said second stream and expand it to said intermediate pressure;

(8) third expansion means connected to said first separation means to receive any remaining portion of said liquid stream and expand it to said intermediate pressure;

(9) a distillation column connected to said first expansion means, said second expansion means, and said third expansion means to receive said expanded combined stream, said expanded second stream, and said expanded remaining portion of said liquid stream, with said distillation column adapted to separate said streams into said more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(10) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded second stream;

(11) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(12) second separation means connected to said third heat exchange means to receive said cooled partially condensed distillation stream and separate it into a residual vapor stream and a reflux stream, said second separation means being further connected to said distillation column to direct said reflux stream into said distillation column as a top feed thereto;

(13) second combining means connected to said distillation column and said second separation means to receive said more volatile vapor distillation stream and said residual vapor stream and form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(14) fourth heat exchange means connected to said second combining means to receive said volatile residue gas fraction, with said fourth heat exchange means adapted

to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby a condensed stream;

(15) fourth expansion means connected to said fourth heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream; and

(16) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

33. An apparatus for the liquefaction of a natural gas stream containing methane and heavier hydrocarbon components, which includes

(1) one or more first heat exchange means to receive said natural gas stream and cool it under pressure sufficiently to partially condense it;

(2) first separation means connected to said first heat exchange means to receive said partially condensed natural gas stream and separate it into a vapor stream and a liquid stream;

(3) dividing means connected to said first separation means to receive said vapor stream and divide it into at least a first stream and a second stream;

(4) first combining means connected to said dividing means and to said first separation means to receive said first stream and at least a portion of said liquid stream and form thereby a combined stream;

(5) second heat exchange means connected to said first combining means to receive said combined stream and to cool it sufficiently to substantially condense it;

(6) first expansion means connected to said second heat exchange means to receive said substantially condensed combined stream and expand it to an intermediate pressure;

(7) second expansion means connected to said dividing means to receive said second stream and expand it to said intermediate pressure;

(8) third expansion means connected to said first separation means to receive any remaining portion of said liquid stream and expand it to said intermediate pressure;

(9) heating means connected to said third expansion means to receive said expanded liquid stream and heat it;

(10) a distillation column connected to said first expansion means, said second expansion means, and said heating means to receive said expanded combined stream, said expanded second stream, and said heated expanded remaining portion of said liquid stream, with said distillation column adapted to separate said streams into said more volatile vapor distillation stream and a relatively less volatile fraction containing a major portion of said heavier hydrocarbon components;

(11) vapor withdrawing means connected to said distillation column to receive a vapor distillation stream from a region of said distillation column below said expanded second stream;

(12) third heat exchange means connected to said vapor withdrawing means to receive said vapor distillation stream and cool it sufficiently to condense at least a part of it;

(13) second separation means connected to said third heat exchange means to receive said cooled partially condensed distillation stream and separate it into a residual vapor stream and a reflux stream, said second separation means being further connected to said distillation column to direct said reflux stream into said distillation column as a top feed thereto;

(14) second combining means connected to said distillation column and said second separation means to receive said more volatile vapor distillation stream and said residual vapor stream and form a volatile residue gas fraction containing a major portion of said methane and lighter components;

(15) fourth heat exchange means connected to said second combining means to receive said volatile residue gas fraction, with said fourth heat exchange means adapted to cool said volatile residue gas fraction under pressure to condense at least a portion of it and form thereby a condensed stream;

(16) fourth expansion means connected to said fourth heat exchange means to receive said condensed stream and expand it to lower pressure to form said liquefied natural gas stream; and

(17) control means adapted to regulate the quantities and temperatures of said feed streams to said distillation column to maintain the overhead temperature of said distillation column at a temperature whereby the major portion of said heavier hydrocarbon components is recovered in said relatively less volatile fraction.

34. The apparatus according to claim 29 wherein said apparatus includes

(1) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream at a location above the region wherein said vapor distillation stream is withdrawn; and

(2) heating means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said heating means being further connected to said distillation column to direct said heated liquid distillation stream into said distillation column as another feed thereto at a location below the region wherein said vapor distillation stream is withdrawn.

35. The apparatus according to claim 30 wherein said apparatus includes

(1) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream at a location above the region wherein said vapor distillation stream is withdrawn; and

(2) heating means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said heating means being further connected to said distillation column to direct said heated liquid distillation stream into said distillation column as another feed thereto at a location below the region wherein said vapor distillation stream is withdrawn.

36. The apparatus according to claim 31 wherein said apparatus includes

(1) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream at a location above the region wherein said vapor distillation stream is withdrawn; and

(2) second heating means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said second heating means being further connected to said distillation column to direct said heated liquid distillation stream into said distillation column as another feed thereto at a location below the region wherein said vapor distillation stream is withdrawn.

37. The apparatus according to claim 32 wherein said apparatus includes

(1) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream at a location above the region wherein said vapor distillation stream is withdrawn; and

(2) heating means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said heating means being further connected to said distillation column to direct said heated liquid distillation stream into said distillation column as another feed thereto at a location below the region wherein said vapor distillation stream is withdrawn.

38. The apparatus according to claim 33 wherein said apparatus includes

(1) liquid withdrawing means connected to said distillation column to receive a liquid distillation stream at a location above the region wherein said vapor distillation stream is withdrawn; and

(2) second heating means connected to said liquid withdrawing means to receive said liquid distillation stream and heat it, said second heating means being further connected to said distillation column to direct said heated liquid distillation stream into said

distillation column as another feed thereto at a location below the region wherein said vapor distillation stream is withdrawn.

39. The improvement according to claim 29 wherein said apparatus includes

(1) second dividing means connected to said separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

40. The improvement according to claim 30 wherein said apparatus includes

(1) second dividing means connected to said second separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

41. The improvement according to claim 31 wherein said apparatus includes

(1) second dividing means connected to said second separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

42. The improvement according to claim 32 wherein said apparatus includes

(1) second dividing means connected to said second separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

43. The improvement according to claim 33 wherein said apparatus includes

(1) second dividing means connected to said second separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

44. The improvement according to claim 34 wherein said apparatus includes

(1) second dividing means connected to said separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

45. The improvement according to claim 35 wherein said apparatus includes

(1) second dividing means connected to said second separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

46. The improvement according to claim 36 wherein said apparatus includes

(1) second dividing means connected to said second separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

47. The improvement according to claim 37 wherein said apparatus includes

(1) second dividing means connected to said second separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

48. The improvement according to claim 38 wherein said apparatus includes

(1) second dividing means connected to said second separating means to divide said reflux stream into at least a first portion and a second portion;

(2) said second dividing means being further connected to said distillation column to direct said first portion into said distillation column as a top feed thereto; and

(3) said second dividing means being further connected to said distillation column to supply said second portion to said distillation column at a feed position in substantially the same region wherein said vapor distillation stream is withdrawn.

49. The apparatus according to claim 29, 30, 31, 34, 35, 36, 39, 40, 41, 44, 45, or 46 wherein said apparatus includes

(1) compressing means connected to said combining means to receive said volatile residue gas fraction and compress it; and

(2) said fourth heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said fourth heat exchange means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

50. The apparatus according to claim 32, 33, 37, 38, 42, 43, 47, or 48 wherein said apparatus includes

(1) compressing means connected to said second combining means to receive said volatile residue gas fraction and compress it; and

(2) said fourth heat exchange means connected to said compressing means to receive said compressed volatile residue gas fraction, with said fourth heat exchange

means adapted to cool said compressed volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

51. The apparatus according to claim 29, 30, 39, or 40 wherein said apparatus includes

(1) heating means connected to said combining means to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said fourth heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said fourth heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

52. The apparatus according to claim 31, 34, 35, 41, 44, or 45 wherein said apparatus includes

(1) second heating means connected to said combining means to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said second heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said fourth heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said fourth heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

53. The apparatus according to claim 36 or 46 wherein said apparatus includes

(1) third heating means connected to said combining means to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said third heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said fourth heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said fourth heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

54. The apparatus according to claim 32 or 42 wherein said apparatus includes

(1) heating means connected to said second combining means to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said fourth heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said fourth heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

55. The apparatus according to claim 33, 37, 43, or 47 wherein said apparatus includes

(1) second heating means connected to said second combining means to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said second heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said fourth heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said fourth heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

56. The apparatus according to claim 38 or 48 wherein said apparatus includes

(1) third heating means connected to said second combining means to receive said volatile residue gas fraction and heat it;

(2) compressing means connected to said third heating means to receive said heated volatile residue gas fraction and compress it; and

(3) said fourth heat exchange means connected to said compressing means to receive said compressed heated volatile residue gas fraction, with said fourth heat exchange means adapted to cool said compressed heated volatile residue gas fraction under pressure to condense at least a portion of it and form thereby said condensed stream.

57. The apparatus according to claim 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, or 48 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

58. The apparatus according to claim 49 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon

components selected from the group consisting of C_2 components and C_2 components + C_3 components.

59. The apparatus according to claim 50 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

60. The apparatus according to claim 51 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

61. The apparatus according to claim 52 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

62. The apparatus according to claim 53 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

63. The apparatus according to claim 54 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

64. The apparatus according to claim 55 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.

65. The apparatus according to claim 56 wherein said volatile residue gas fraction contains a major portion of said methane, lighter components, and heavier hydrocarbon components selected from the group consisting of C_2 components and C_2 components + C_3 components.